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PUBLIC WORKS

CITY COUNTY STATE

TRUCK AND TRAILERS OF THE PEORIA GARBAGE DEPARTMENT STARTING FOR THE DUMP.

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DECEMBER 17, 1921

Modern Methods of Street Sweeping

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The Ohio Municipal Equipment Co.

Columbus, Ohio

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PUBLIC WORKS.

CITY COUNTY STATE

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Vol. 51 DECEMBER 17, 1921 No. 25

Centrifuges for Dewatering Sludge*

By T. Chalkley Hatton†

Sludge used by farmers in Germany dewatered by filter presses and centrifuges, the latter different from any heretofore used in this country and described in this article.

Every engineer engaged in the study of sewage disposal by modern methods recognizes that the art is divided into two distinct problems—the partial purification of the liquor and the disposal of the sludge—and that the latter is, of the two, the more difficult to satisfactorily solve.

For many years—in fact up to the present—sludges produced by many of the English sewage disposal plants were deposited upon ground and plowed in. After a few seasons of this practice, the tracts of ground set aside for this purpose became sour and unable to digest the organic matter. They were, therefore, abandoned.

The largest sewage disposal plant in England, the Birmingham plant, is now lagooning the sludge, monopolizing a large tract of most excellent ground which could otherwise be used for the production of foodstuffs of which the country stands so greatly in need. This method not only destroys the real value of the ground but constitutes a nuisance to the immediate neighborhood.

To sum up my impressions after a recent visit to many of the sewage disposal plants of England: There was none (except disposal at sea) where the disposal of the sludge was being handled so as to avoid a nuisance. In fact, it was creating a far greater nuisance than the clarification of the sewage, and but little progress appears to have been made since my last visit in 1907.

I had an opportunity to compare the relative advantage of the methods employed in Germany and England.

The sludge problem, my observation showed, was studied with painstaking care and considerable skill by the German engineer. Recognizing that he had a product for which there was a market, he proceeded to make sure of this market by preparing and delivering his product so as to give satisfaction to the ultimate buyer.

The English engineer, on the other hand, starts with the assumption that the English farmer and truck grower will not use sludge in any form, no matter how well prepared and conveniently delivered. He ignores the requirements of his potential customers and produces his sludge in a form best suited to himself. It is to be regretted that the American engineer has adopted the same negative point of view.

Modern agricultural chemistry shows that all sludges produced by sewage disposal plants contain sufficient fertilizer value in the form of nitrates (ammonia and humus) to warrant their use by the farmer or small truck gardener, provided the cost of handling is not too great. That the sludges produced from plain sedimentation may be profitably used by the agriculturist when the wagon haul does not exceed five miles and providing the sludge contains not more than 75 per cent moisture, was demonstrated by the Agricultural Department of the late Imperial German Government as far back as 1912. The German Government from that time on prepared and distributed literature instructing farmers in the most approved ways of using sludge as a fertilizer.

What has been the result? Hamburg, Hanover, Frankfurt-on-the-Main and many other German municipalities are disposing of their sludge to the surrounding communities so effectually as not to have a dozen wagon-loads left on hand any one night. In fact, the demand is so great that each customer is given his own day in the month when he must

*Presented before the Sanitary Engineering Section, American Public Health Association.

†Chief Engineer of Sewerage Commission, Miwaukee, Wis.

come for his apportionment, for which he pays a certain sum fixed by the government. While this sum is not sufficient to meet the cost of dewatering the sludge, it defrays at least a part of the expense. More important is the fact that the sludge nuisance is eliminated while the prosperity and productivity of the community are materially advanced.

Now how has Germany accomplished what none of the rest of the world has been able to achieve?

First, by preparing its product to meet conditions under which the consumer can handle it.

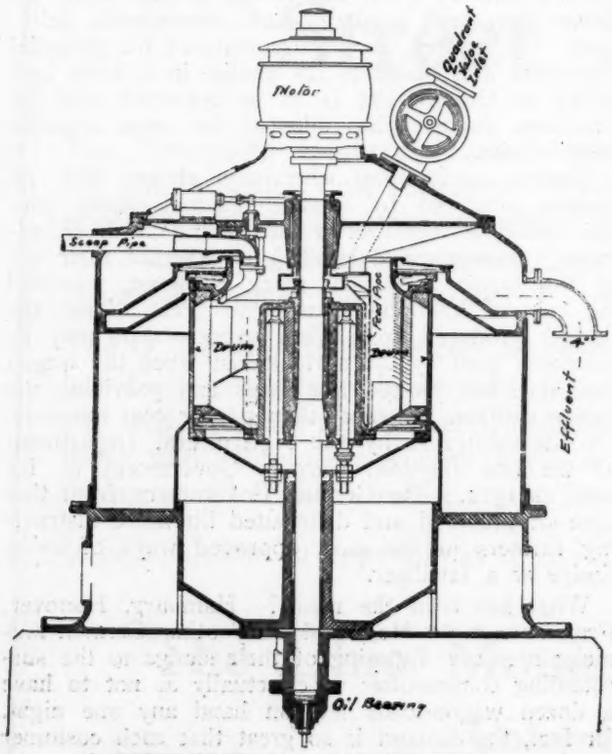
Second, by educating the consumer, through national and local government bureaus as to the value of the product and the best methods of using it.

As a result of these two important services, a market for all the sludges produced has not only been found but is being extended more rapidly than the demand can be met.

That sludge which has been properly prepared need not look far or long for a buyer has been proved by at least one progressive English municipality. The city of Bradford, after extracting the excess grease from its sewage through filter presses, breaks up the cake by means of a disintegrator and thus finds a ready and profitable market for it among the fertilizer manufacturers.

Notwithstanding the fact that Bradford's raw sewage is notoriously offensive, the neighborhood around the disposal works is free from unpleasant odors. This is due in part to the effective methods employed and in still greater part to the prompt shipment of the sludge to the consumer.

The Germans have prepared their sludges by partial dewatering through both filter presses and centrifuges and the sludges so treated are produced mainly from plain precipitation. The filter presses in use are quite similar to the types in common use



CROSS-SECTION OF CENTRIFUGE

in America from which about the same results are obtained. The centrifuges, however, are quite different from any the writer has heretofore seen, and are worth a brief description.

The machine is made by the "Hanomag" Works at Hanover-Linden, Germany. It was designed by Dr. ter Meer, director of the Hanomag plant and Mr. George Froboese, his master mechanic. During the war, the American patents became the property of the custodian of enemy property and were purchased by the Barth Engineering and Sanitation Company of New York City, which changed the name of the machine to "Besco-ter-Meer."

Unlike most centrifuges, the machine is continuous and automatic in its operation and is devoid of all screens. It can be set to feed, discharge, post centrifuge and scoop at any cycle or combination without any manual control. It builds up its cake against a solid stationary plate and unloads it by dropping below this plate the depth of the bowl, the cake being thrown out of the bowl by centrifugal force into a chamber equipped with revolving scrapers which remove it to the point of discharge.

Because the machine is of more than passing interest to the sewage disposal engineers and because we have been operating one in the testing station of the city of Milwaukee for six or eight months, the writer has included two cuts of the enlarged machine showing a photograph of the machine as set up (this is not reproduced), and a cross section through the center. The important dimensions are as follows: Inner diameter of drum 44 inches; drop of drum when discharging, 20 inches. Depth of cake chamber to overflow zone, 24 inches. Thickness of cake formed, 9 inches. Operating oil pressure to support shaft drum and motor, 210 pounds per square inch. Total height of machine including motor, 10 feet. Diameter of outer housing, 6½ feet. Weight of machine, approximately 10 tons, R. P. M. 1,000. Main drive motor, 35 h.p. slip ring. Oil pump motor 10 h.p. Automatic control motor, 2 h.p. Inlet valve designed to automatically control rate of feed during cycle.

Average records taken from two disposal plants where these centrifuges have been in use for several years will fairly illustrate the ability of the machine to dewater sludges from plain sedimentation. At the Herrenhausen Sewage Disposal Plant, which treats the sewage from Hanover-Linden, amounting to 40 million gallons daily, plain sedimentation only is carried out for clarification. The time of detention is two hours. Every two days one of the 12 sedimentation tanks is emptied and the precipitated solids, amounting to 70 per cent of the total suspended solids in the raw sewage, is run to sludge storage tanks.

This sludge, containing 96 per cent moisture, passes through a 9 m.m. mesh screen and into one of three 36-inch centrifuges, each of which delivers 11 cuubic yards of cake per hour, containing from 72 to 75 per cent moisture, the filtrate being returned to the raw sewage. The cycle of operation is four minutes, which embraces filling, centrifuging and discharging. Each machine requires 25 h.p. motor to operate and one man looks after the operation of all the equipment in the centrifuging house. Screw conveyors carry the cake from the machines

to outside the building where it is loaded upon wagons by the farmers and hauled away.

The sewage disposal method in use at Frankfort-on-Main consists of fine screening, three-quarters of an hour detention in sedimentation tanks and dewatering of sludge. Seventy-five per cent of the suspended solids are removed by sedimentation and these are removed from the tanks after about seven days' operation, becoming quite septic before further treatment.

Eight 36-inch centrifuges are installed, each of which operates 1,200 hours per month, producing 15,000 cubic meters of cake with 70 to 75 per cent moisture, or about 16 cubic yards per hour, the filtrate being returned to the raw sewage. Each centrifuge is operated by a 15 h.p. motor. Counting the screen, agitator and oil accumulator, each centrifuge requires 20 h.p. to operate and one skilled laborer looks after all the plant inside the centrifuge house. The sludge is carried from the centrifuges by means of screw conveyors to direct heat dryers where the moisture is reduced to 15 per cent.

During the war, the drying plant was cut out and the sludge cake from the centrifuges has since been conveyed by hand-pushed cars to a dump, from whence it is removed, as fast as deposited, by farmers and truckers who pay four marks per wagon-load containing 2.6 cubic yards.

Compare this extremely sanitary method of disposing of sewage sludge, where no man handles it except to load the partially dried material in wagons, and where it cannot be seen from the time it leaves the sedimentation tank until it reaches the dump cars, with the present unsanitary and highly offensive method used, for instance, in the sewage disposal plant of the city of Baltimore, or, in fact, in any other of the modern plants in this country and England.

It is the writer's opinion that the English and American engineers have failed to grasp the idea that satisfactory sewage disposal is not accomplished by merely treating the liquor so that the effluent shall not produce a nuisance to the body of water into which it is finally discharged. It is no less essential that the sludge produced from such treatment should be so disposed of as to reduce to a minimum the nuisance and danger to workmen engaged at the disposal plant, and to the adjacent neighborhood. If, in doing this, the values contained in the sludge can be conserved, and two blades of grass be made to grow where one is now growing, the common welfare is undoubtedly improved.

The tendency in most disposal plants is to get rid of the sludge in the cheapest manner possible regardless of the temporary or permanent nuisance resulting. Until this tendency is overcome, the disposal of sewage will not prove satisfactory from the public viewpoint.

The writer believes from his experience in operating and viewing the operation of centrifuges in dewatering sewage sludges and water-laden solids in the industries that centrifuges of the proper type can be economically used in a great many disposal plants in this country and in Europe to displace the crude methods now practiced; that centrifuging will prove far more sanitary; that it will dewater the sludges so that they can be easily and profitably handled by the farmer and trucker and will thus create a steady market for all produced. He firmly believes it the province of the Sanitary Engineering Section of the American Public Health Association to put a little "pep" into the Bureau of Soils of the Federal Agricultural Department, with the object of inducing the latter to carry out intelligent growing experiments with sewage sludges from the various types of plants, to publish the results of such experiments and to give these publications proper circulation among those most likely to benefit therefrom.

Dr. Nasmith, of the Toronto Board of Health, Dr. Bartow, late of Urbana, and a few others, have carried out some experiments to show the probable value of activated sludge. All of these experiments, particularly those conducted by Dr. Nasmith, have demonstrated the growing value of the sludge as compared with other fertilizers and the natural soil.

In estimating the cost of centrifuging sludge per capita, the writer would use the Hanover plant as fairly representing what has been done for several years, and applying American prices.

Hanover operates two centrifuges for 10 hours per day. Each machine uses power at the rate 10 k. w. per hour. One skilled laborer is employed inside and one common laborer outside. The population of Hanover is 320,000. At present prices, the two centrifuges and equipment would cost $32,000, which includes tanks, screens, and conveyors. The building should be built for $10,000.00 Estimating 6 per cent for interest and 6 per cent for depreciation, plus $200.00 per machine for minor repairs; three cents per k. w. hour for current; $5.00 for skilled and $4.00 for common labor and 8 hours per day, we have the following costs:

12 per cent on $32,000	$3,840.00
2 per cent on $10,000 (building)	200.00
Minor repairs, $200 per machine	400.00
52560 k. w. hrs. power at 3c	1,576.80
313 days' labor at $9.00	2,817.00
10 per cent for contingencies	883.38
Total annual cost	9,717.18

$9,717.18÷320,000=3c per capita.

Experiments have been conducted at the Milwaukee Sewage Testing Station since October, 1920, upon a Besco-ter-Meer 36-inch centrifuge in dewatering activated sludge. The machine, as first delivered, was designed to operate at 900 R. P. M. which did not produce sufficient centrifugal force to produce a cake low enough in moisture to handle satisfactorily. The speed was increased to 1,300 to 1,350 R. P. M. and much better results secured.

Activated sludge has an average specific gravity of 1.005 and is flocculent but the floc is of such a character as to be readily broken up and reduced to very fine particles when violently shaken. It is therefore extremely difficult to dewater by means of any apparatus which destroys the floc.

After somewhat changing the design of the drum so that a more uniform velocity of flow of sludge passing through it could be maintained, we have been able to reduce the moisture from 98 to 83 per cent at a rate of about 4 pounds of wet cake per minute, removing from 70 to 80 per cent of the suspended and settleable solids in the sludge.

This produces a cake which can be easily handled but the filtrate, containing from 20 to 30 per cent of the suspended and settleable solids in the sludge, is very difficult to satisfactorily treat.

If it is run back into the raw sewage, the sludge begins to pyramid until the aeration and sedimentation tanks accumulate more sludge than the plant can handle. Many experiments have been made to overcome this condition but up to the present time none has been successful.

The writer is not yet prepared to state that the centrifuge will or will not successfully dewater activated sludge but he feels sure, after having three types operated at Milwaukee and viewing the results obtained in America and Europe by centrifuges, both in industries and sludge disposal, that there is a need for them in the latter service, especially where sludges from plain sedimentation are to be handled.

In closing this brief paper, there are two points to which I wish to call your particular attention; the *first* is the necessity for the sanitary engineer to give greater study to better methods for disposing of sludges from sewage disposal plants. In considering this phase of the subject, it might be well for the engineer to look into the general question of the conservation of nitrogen produced by sewage sludges and what it means to communities surrounding the place where the sludges are produced. Mr. Kenneth Allen, in his paper on "Nitrogen," published in the *Engineering News Record* of August 25, 1921, p. 311, touches upon this matter and refers to Dr. Fowler's very valuable paper on "The Conservation of Nitrogen." Some time might also be devoted to the study of the values which are obtained from tankage by the large packing houses of this country. After absorbing this information the conclusion will certainly be reached that the values in sewage sludges are well worth conserving when handled in a sanitary manner and the sludges produced in a condition which can be practically handled by the consumer. The *second* is the desirability of using the Association's influence in securing the services of the Federal Department of Agriculture in thoroughly investigating the value and use of sewage sludges as a fertilizer.

Highway Preparedness in West Virginia

West Virginia has set an example in preparing for highway work in 1922 which should be followed by every state of the Union that has not already taken or prepared to take similar action. On November 17th it awarded contracts for road work to be done next year, thus giving the contractors abundant time to obtain and transport materials and make preparations for actual construction as soon as the weather conditions permit in the spring. In fact, it is probable that some of the work may be done during the winter, especially the grading.

Nine contracts were let located in as many counties of the state and totaling about 39 miles, the total amount of bids reaching about $750,000. Four include grading and draining only and the other five include, in addition, paving with bituminous penetration macadam in three cases and with concrete in the other two.

Refuse Collection in Peoria

By E. E. Pierson

The refuse of Peoria, Ill., is collected under two classifications, ashes and rubbish in one and garbage in the other. The ashes and rubbish are dumped in low places about the city, while the garbage is taken by a company known as the Peoria By-Products Co., which feeds it to pigs.

The cost of collection is said by Charles Kaufmann, superintendent of ash and garbage collection for the city, to have been greatly reduced by the use of the trailer system, which was adopted about a year ago. The total cost of operating in 1920 was $55,846 and the cost for 1921 will probably be about the same. For this sum collections of ashes, rubbish and garbage are made from an estimated number of 24,000 households, giving the annual cost as $2.32 each.

During the summer months the amount of garbage collected averages 12 loads per day, but only 6 loads per day during the winter months. Ashes and rubbish average about 85 loads a day. The city is divided into 16 districts or routes for ash and rubbish collection and into 4 routes for garbage collection. During the first four days of each week collection is made from alleys and during the last two days from those houses which do not hav access to alleys. It is required that garbage, ashes and rubbish be placed, in receptacles of a size that can be handled by the collectors, in alleys where there are any, and otherwise on the street curb Garbage is collected twice a week during the summer months and once a week during the fall, winter and spring.

Collection is made in small trailers which when filled, are brought to the headquarters of the garbage department. At this point the trailers are connected up into trains of 4 to 6 and are hauled by trucks to the dump or the yards of the By-Products Co. From May first to October first 4 men and about 12 trailers collect the garbage, and about half this number during the fall and winter. The trailers used in collecting the garbage are owned and furnished to the city by the By-Products Co., but are loaded and hauled to the company's yard by city employees and trucks. (A tractor and train of trailers in front of the department's office is shown on the front cover of this issue.)

Asphalt Paving in Pittsburgh

Pittsburgh, Pa., laid 484,280 square yards of asphalt pavement in 1921, all of this having been done by the city direct and not by contract. This is more than double the amount laid in 1920. This statement was made by Director of Public Works Norman F. Brown on November 15th, and it was his expectation to increase the total by 50,000 to 100,000 square yards if work remained favorable for a sufficient number of weeks longer. This work includes the repaving and repairing of streets in the residential section and the construction of park roads.

Duncannon Highway *

Preparation of roadbed, mixing, placing and curing of concrete. Special pains to secure proper consistency and protection of concrete, location and construction of expansion joints.

The old road surface was thoroughly loosened by a Western Grader Company's scarifier and after being brought to required grade was compacted by continual operations of two 10-ton Buffalo-Pitt rollers until a satisfactory flat surface was everywhere secured, and all soft spots and irregularities corrected and rerolled.

All culverts were constructed well in advance of the rolling. Great care was taken in setting the reinforced concrete culvert pipes, which were never placed in the fill, but were invariably set in carefully prepared beds with excavations for the hubs in the undisturbed surface of the solid ground. The pipe was placed with a grade of 1 to 30, the joints thoroughly filled with cement mortar and the ends protected with head walls and the pipes themselves well covered with thoroughly tamped earth before the backfill was placed and subgrade rolled above it.

PAVEMENT FORMS

The concrete pavement was laid between Blaw-Knox steel forms, of which 2,000 linear feet were provided and at least 200 feet were always laid in advance of the concrete mixer. They were kept thoroughly greased and carefully inspected for straightness and cleanness before using, were carefully set by long spirit levels and firmly staked in position. The alignment to tangent was made by setting the forms to a tightly stretched string on one side of the pavement and by careful measurements for the opposite side. On curves of more than 300 feet radius the steel forms were bent or sprung to accurate conformity with the tabulated ordinates to the chords given in the inspector's hand book of instructions.

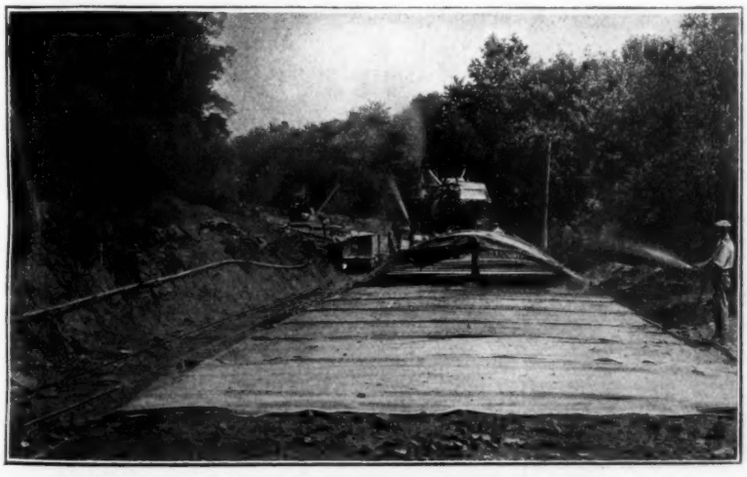
*Part I, General description. Grading Excavation, storage yard and delivering of aggregate was published last week.

STEAM ROLLER STRAIGHTENING ROLLS OF REINFORCEMENT FABRIC

CONCRETE MIXING

The 1:2:3 concrete was mixed in a 5-bag Koehring mixer, which, however, was only operated as a 4-bag machine, thus turning out 24 cubic feet of concrete in a batch. Each batch was mixed at least 1¼ minutes, and the average output of the machine was 300 linear feet per day with a best record of 455 linear feet, one batch of concrete sufficing for 1.4 linear feet of pavement 18 feet wide. The mixing machine was operated at not less than 14 nor more than 20 revolutions of the drum per minute and great care was taken to secure the proper mixing and consistency of the concrete, the bags of cement being occasionally checked by weighing, and strict watch was observed to prevent loss through leakage or careless handling of the bags. The empty bags were counted, piled and recorded at short intervals, and the cement was protected from wind and weather while it was handled and transported.

Care was taken to secure uniform and satisfactory consistency of the mixture that would afford from 65 to 85 per cent of the maximum strength of the concrete, which was made extra dry on account of the machine finishing. The amount of water was controlled by an automatic measuring device adjustable to different requirements occasioned by changes in the aggregate or by weather conditions. The mixer was also equipped with an automatic batch meter that locked the machine so that the concrete could not be discharged until after the aggregate had been mixed the required length of time.



FRESH CONCRETE PROTECTED BY CANVAS COVERS AND BY FLAT SHEETS OF BURLAP

PLACING AND FINISHING CONCRETE

Before placing the concrete, the surface of the foundation was carefully tested by the scratch template applied just behind the mixing machine so as to detect any elevations or depressions in the surface by scratches made by projecting sharp points or by their absence in hollow spots. The former being shaved and the latter filled and rolled if necessary.

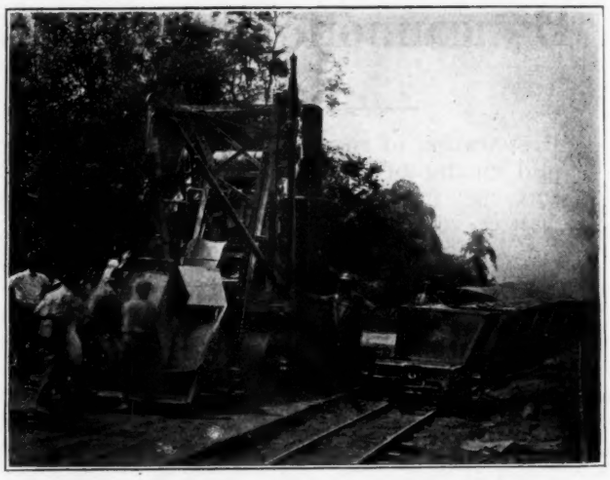
The mixer, mounted on caterpillar traction, travelled on the subgrade without injury to it and discharged the concrete into a bucket travelling on a horizontal boom swung back and forth across the pavement and distributing the concrete in a narrow stream through a long opening in the bottom of the bucket transverse to the axis of the road, thus eliminating most of the hand placing of concrete, which was done entirely by shovels, the use of rakes not being permitted.

The mixer was followed closely by a Lakewood finishing machine, that went over the surface of the concrete four times, operating the belt finisher from 2 to 4 times according to conditions. Care was taken to operate the finishing machine with great uniformity, it was moved slowly with only a small amount of extra concrete permitted to accumulate in advance of the blade. Whenever the machine came to a stop it was moved back a short distance and then when it was again started tamping was not resumed until after it had advanced a foot or more. The joints were finished with a wooden float operated from a bridge spanning the pavement. The outer edges were rounded to a radius of ¾ inch and the joints to a radius of ⅛ inch. The forms were not removed until after the concrete had been in place 24 hours.

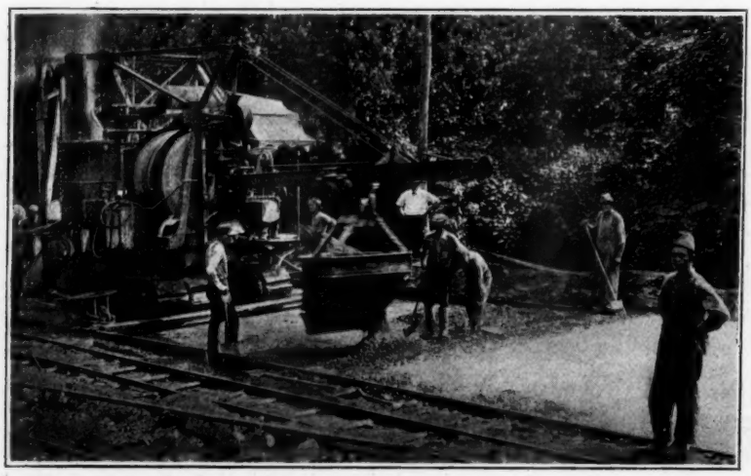
EXPANSION JOINTS

The expansion joints were located at both ends of convex vertical curves, at the upgrade sides of concave vertical curves, and on horizontal curves at the P. C.s and P. T.s and at some intermediate points, with a minimum distance of 100 feet between joints.

The expansion joints were laid against perfectly smooth, straight and well greased steel bulkheads placed on the side next to the mixer secured by at least 10 temporary steel pins, 12 to 18 inches in length, and at least 5 additional permanent pins driven against the Elastite filler, with their tops 2 inches below the surface of the concrete. After at least 10 feet of concrete had been placed beyond the bulkhead, the latter was removed subsequent to gentle spading, and the surface of the adjacent pavement finished by a careful workman and tested with a 6-foot straitedge. At the end of each half day's work a transverse construction joint was formed against a 3-inch wooden bulkhead. Expansion joints were placed at a maximum distance of 300 feet apart and an average distance of 150 feet. The concrete mixer was operated by a gang of 15 men and laid 415 linear feet of pavement per 10-hour day for one week, when the average haul was about 4 miles.



AGGREGATE IN BATCH BOXES HAULED ON INDUSTRIAL TRACK AND DELIVERED TO HOPPER BY DERRICK ON MIXER



DELIVERY AND SPREADING CONCRETE FOR FINISHING MACHINE

PROTECTION OF CONCRETE

As soon as the concrete was finished it was protected by several canvas covered frames 14 feet long, extending across the whole width of the pavement. Each frame had transverse ribs consisting of a horizontal bottom chord to which there was attached a long upper wooden arch strip sprung to a curve having a rise of about 4 feet at the center. These frames were handled by four men each and as fast as they were moved forward close to the mixer, leaving the fresh concrete uncovered, the latter was immediately protected by transverse strips of burlap 9 feet wide with wooden cleats nailed across the ends to keep them straight and facilitate handling.

On the following day the burlap was moved forward and the concrete covered with 2 inches or more of dirt that for at least 8 days, excepting in cool weather, was kept saturated by sprinkling.

The reinforcement fabric was received in rolls 250 feet long and 6 feet wide, which were delivered from the contractor's yard to the subgrade a short distance in advance of the mixer. The fabric was unrolled and spread, convex side up, on the hard level surface of the finished subgrade and rolled flat and straight by the 10-ton road roller moving back and forth over the full length one or two times, after which the fabric was cut into 18-foot lengths by a man with a measuring pole and a pair of heavy shears. This method was found to be more economical, quicker and more satisfactory than the use of rolls for straightening the fabric.

The concrete was deposited in two immediately successive layers, the first leveled

off to an elevation 2 inches below the required surface and on it the reinforcement was placed with transverse overlaps 6 inches wide, after which the remainder of the concrete was immediately spread over it and finished by the gasoline driven machine.

TEST SAMPLES

At distances of about 1,500 feet the inspector took about 6 shovels of concrete from different places in the pavement covered by one batch after it was spread on subgrade, and before it was finished, and with it filled three special parafined cylindrical 12- x 12-inch and 12- x 6-inch paper moulds. These moulds were filled with a trowel and the concrete thoroughly puddled with a 1-inch iron rod, after which they were rotated on their vertical axis on the baseboard to insure parallel flat top and bottom bearing surfaces, and were covered for 24 hours with a damp cloth, and 48 hours more with moist earth, after which they were boxed, labeled and sent to the testing laboratories where they were tested when seven days old.

The contractor, McArthur Bros., employed an average total force of 208 men at wages of $.30 for labor and $.45 to $.75 per hour for mechanics. All of the labor was native born and many of the men came from local farms in 30 or more of their own automobiles, which presented rather an unusual appearance parked along the right of way during working hours.

Additional Work on Catskill Aqueduct

Steel pipe lines to be constructed in fourteen inverted siphons, to cost over six million dollars

Bids were received on November 10th for over $6,000,000 worth of work in enlarging the capacity of the Catskill aqueduct of New York's water supply, and the three contracts covering this work have since been awarded to Rice & Ganey, Inc., Frederick Snare Corporation and Thomas Crimmins Contracting Co., all of New York city, the low bidders on the three contracts.

It will be remembered that in building the original Catskill aqueduct, which was described in "Municipal Journal" for Jan. 19, 1910 and Aug. 23, 1911, the aqueduct was constructed of a considerable number of sections, some in tunnel and some of steel pipes, the latter being used as siphons in crossing valleys. The tunnels were made of sufficient capacity to carry the entire discharge of the Catskill water sheds which it was intended to bring to the Ashokan dam, since it was calculated that this would be cheaper than to build a smaller tunnel at first and another some years later when it became necessary. But in the case of the siphons, which are largely in cut and cover, it was calculated to be more economical to provide three lines of steel pipe and build only one of these at first, the others to be added later when increased consumption might demand them. In addition to financial considerations, it was thought that the opportunity to study rates of flow and the general working of the first siphon might permit improvements in the design or construction of the others which would be well worth while.

The present contracts are for completing the siphons and thus the entire aqueduct by adding at each siphon two additional lines of siphon pipes. There are 14 siphons, or 28 pipes, included in the three contracts above referred to. These are to be laid parallel to the pipe lines previously constructed and will be built in practically the same way, with a cement lining and a concrete outside cover, the pipes resting in concrete saddles, all as described in the article in our issue of August 23, 1911.

The grades of the tunnel sections at the ends of each siphon line are so located as to provide fall in the siphon sufficient to keep the flow line in the tunnels at the desired height at each end of the siphon at the normal rate of flow. In order to effect this, the sizes of the additional siphon pipes now to be added have been carefully calculated and vary in the different siphons depending upon the available head. The thickness of steel in the pipes of course varies with the head.

The first contract includes three siphons in Ulster and Orange counties; the second contract includes seven siphons in Putnam and Westchester counties; and the third contract includes four siphons in Westchester county, each siphon containing two lines of pipe. The pipes in the first contract comprise 5,605 feet of 8-foot, 4-inch pipe and 6,550 feet of 8-foot 10-inch pipe. The second contract comprises 1210 feet of 7-foot 4-inch pipe, 1380 feet of 7-foot 10-inch pipe, 5985 feet of 8-foot 4-inch pipe, and 25,320 feet of 8-foot 6-inch pipe. The third contract comprises 19,950 feet of 11-foot 3-inch pipe. The thickness of plates used in the pipes varies from 7/16 inch to 9/16 inch, lap joints being used in some cases and longitudinal butt joints being used in others.

The above sizes of pipe are those of the steel shell, but the effective size of the siphon will be reduced by the mortar lining, which is two inches thick, thus reducing the effective diameter by 4 inches in each case.

The lining is to consist of Portland cement and sand mixed as may be ordered, but generally one part cement to from 1 to 2 parts of sand if the mortar is poured into forms; although other mixtures may be specified if the lining is to be applied by a cement gun or in other ways suggested by the contractor and approved by the engineer. In pouring the lining, suitable forms are to be placed inside the pipe and the mortar, mixed to a thick, creamy consistency, will be poured through holes not more than 2½-inches diameter that are left in the top of the pipe at intervals. The pouring is to be continued until the mortar rises to a height of at least 4 feet in a vent pipe connected to the siphon pipe at the highest part of the section being poured; these vent pipes to be kept filled with grout until the motor is set, when they will be removed and the holes made tight by screwing iron plugs into them. The holes are reinforced by plates riveted to the pipe. During the pouring of the grout the forms are to be tapped to loosen air bubbles

and all leaks in the forms must be stopped. The pouring of grout must be continuous from start to finish with no interruption of pouring exceeding 15 minutes. Where there are portions of the pipe which it is impracticable to line by grouting, plastering may be employed, the mortar being put on in thin layers, the surface of each layer to be brushed to thoroughly remove the laitance and scratched deeply to give a bond with the succeeding layer. In crossing Tongore creek, the exterior of the pipe is to be covered with mortar having a minimum thickness of 1½ inches and reinforced with steel fabric weighing not less than 0.3 pound per square foot. During the pouring of the lining in freezing weather, bulkheads will be placed in the pipe to keep out the cold air and prevent the freezing of the lining.

The outside of the pipe is to be covered with concrete having a minimum thickness above the spring line of 6 inches, with the outer surface vertical below the spring line and the thickness under the invert varying with the condition of the soil.

In carrying on the construction, the top soil is to be removed from designated areas before beginning the general excavation for the pipe trench to provide surface drssing for the embankments. Foundation embankments are to be completed at least six weeks before masonry is laid on them and should therefore be the first part of the contract to be performed. The steel pipes after being laid are to be tested and made tight against hydrostatic pressure corresponding to the hydraulic gradient of the aqueduct, and the outside concrete is to be placed while they are still under this pressure.

The quantities run into quite high figures. For instance, in the second contract the estimated quantities include 25,00 cubic yards of removal of soil, 218,000 cubic yards of earth excavation and 21,600 cubic yards of rock excavation; 203,000 cubic yards of refilling and embanking and 22,000 cubic yards of surface dressing. 100,000 pounds of steel will be required for reinforcing the concrete, of which there will be 1000 cubic yards reinforced and 44,800 cubic yards not reinforced. There will be 880,000 square feet of mortar lining in the steel pipes.

The contractor is required by state law as well as by the contract to make proper sanitary provisions for the men in camps and on the work, but it is hoped that practically all of the men except those on the work nearest to the Ashokan dam and the watchmen and a few others, will live in neighboring towns and villages and thus eliminate the objectionable features of construction camps. However, the contracts require that the contractor furnish medical and surgical practitioners, estimated, for the second contract, at 150 practioner-months, 40 months of sanitary services, 25,000 pounds of chlorinated lime and 60,000 pounds of liquid chlorine to be used in 10 automatic chlorine dosing machines, while the other contracts call for amounts somewhat less than this. The times of services given above are estimated but "the contractor shall employ medical and surgical practitioners to the number required from time to time. For each such practitioner employed in accordance with orders the contractor shall receive payment at the rate per month stipulated." Under sanitary services the specifications include the care and maintenance of the sanitaries; the collection, disinfection and disposal of garbage, excreta and other waste; the maintenance and operation of sewers, sanitary drains and chlorination and other disposal works; the disinfection and fumigation of quarters, stables and grounds; care of the health of the employees; lighting of the camps and other surroundings, etc. Compensation for each of these is to be at the price per month stipulated, the time of payment being considered as beginning when a force of men begins the erection of the sanitary conveniences, and will be considered as ended 15 calendar days after the removal of the last of these conveniences has been authorized. The liquid chlorine machines are to be used for sterlizing drainage or stream flow in order to prevent morbific pollution of waters flowing in the several watersheds crossed by the aqueduct.

SOME SPECIFICATION ITEMS

The specifications contain several features out of the ordinary. The successful bidder is required to give bonds of $250,000 in the case of one contract and $500,000 for each of the others. "At the expiration of each year after the date of onctract, the liability of the sureties under the bonds will be reduced in the proportion which the amount of work done at that time, as shown by the partial estimates, bears to the estimated amount certified by the board to be expended under the contract, until such liability shall amount to 20 per cent of the original liability, at which amount the bonds shall remain in full force and virtue until the completion of the entire work."

"The attention of bidders is especially directed to the time for the completion of the various parts of the work. Such rates of progress will be required as will give assurance of the completion of all parts of the work within the prescribed time."

"The attention of intending bidders, particularly those who may fail to appreciate the essentials through lack of experience in water works construction, is directed to the exacting requirements of the specifications intended to assure safe, watertight and otherwise adequate structures. The bidder should realize fully that the first-class materials and workmanship specified must be supplied in full measure in order to produce acceptable structures of the kind specified."

Provision is made for work or materials that are "not susceptible of classification under the items of the contract" but which may be ordered by the engineer, for which the contractor shall be paid cost plus 10 percent, administration, general superintendence and profit to be included in the 10 per cent and not in the cost. However, such special work cannot in any case exceed 5 percent of the estimated amount of the contract.

The contractor is required to pay the workmen in cash and not in store orders or other script, nor will he be allowed to conduct a company store if there is a store selling supplies within two miles of the place where the contract is being executed.

The contractor is required to give a bond in the sum of $5,000 to each municipality in which his work may be located to indemnify such municipality against "any loss, expense or charge that said municipality may legally incur because of paupers or indigent employees brought into said municipality and having no settlement therein."

Partial estimates are to be made by the engineer as a basis of payments not oftener than once a month, but no estimate will be made unless the amount of work since the previous estimate totals at least $10,000. Ten percent is retained from the monthly estimates.

Considerable variation in the bids, both for the several items and the total bids, were submitted by the various bidders. For instance, for the first contract (known as contract No. 209), the low bidder, who received the contract, submitted as his total $999,325, while the total for the highest bidder was $1,998,826. In the various items the difference was still greater. For instance, for earth excavation the low bid was $.80 a cubic yard and high bid $4.50. In the lump sum for stream and highway crossings, the lowest bid was $6,000 and the highest bid $160,000. For furnishing and laying the steel pipe the bids varied from $25 to $75 per foot for the lighter weight and from $35 to $110 for the heavier weight. It would seem as though the concrete masonry, delivered in bulk between the pipe and outside forms, would not offer sufficient departure from ordinary construction or sufficient risk to lead to much difference in prices, but the bids varied from $6.42 a cubic yard to $27. For furnishing automatic chlorine dosing machines the bids ranged from $1000 each to $5000. The greatest difference of all was the lump sum item of cleaning up, for which one contractor bid $500 and another contractor $14,800.

While in a general way the low bidders were low on all items and the high bidders were high, this did not follow consistently through all the items. For instance, the highest bidder bid $1.00 a cubic foot for "cutting concrete," while the average of all the bids was $4.21; also his bid for steel castings was 12 cents while the average of all bids was 18 cents. The low bidder was only about 5 percent below the next lowest, and his bid was apparently well-balanced, as in the case of only a few minor items were any of his bids higher than the average of all the bidders.

Unemployment in New York State

During November the secretary of the New York State Bureau of Municipal Information, William P. Capes, wrote to the mayors of all the cities in the state of New York asking concerning the condition as to unemployment in their respective cities. Forty cities replied and the general tenor of these replies bore out the opinion which we have already expressed that, in this section of the country, the amount of unemployment is little more than is usual at this time of the year. A number of these cities described plans which they were making for relieving or preventing unemployment, but did not state what amount of unemployment there was at present in the city. Of those that replied, seven stated that conditions were normal; nine that conditions were not serious; six that there was no unemployment; 4 that there was little unemployment, and one that labor was quite scarce.

The mayor of the last named place, White Plains, wrote: "There is very little unemployment in White Plains, in fact it was necessary for me to give a representative of the 'Builders' Trade Council' a letter so that he might go to the various cities in the state and hire mechanics to come to White Plains."

Among those listed as not serious is Tonawanda, whose mayor wrote: "The city has built a filtration plant at a cost of $250,000, has paved streets at a cost of $222,000, has laid new water mains at a cost of $50,000, and has constructed new sewers at a cost of $40,000. This and other work that has been and is now being done by private individuals have relieved the situation in our city considerably. The situation has not been bad and is not now, as our charity disbursements are not any more at the present time than they were a year ago."

Albany's mayor reported that he attended a meeting of representatives of the Chamber of Commerce and all the charity organizations and that "The conclusion we arrived at was that the situation in the matter of unemployment was about normal and we deemed it advisable not to disturb our people by the appointment of any committee on unemployment at the present time."

Profits from Muncipal Dam

The city of Fort Dodge, Iowa, with about 30,000 population, completed the construction of a municipal dam in March, 1918. This dam, which is 412 feet long with a 230 foot spillway section, was described in our issue of May 11, 1918. It was built under the plans and supervision of Burns & McDonnell of Kansas City as engineers, which firm also conducted a bond campaign under the auspices of the Commercial Club, which was carried by a large majority in June 1916. The engineers had calculated that the dam with its hydro-electric plant would be a profitable investment for the city, in addition to which there was the very influential reason that the dam would create a lake that could be utilized for pleasure purposes. The dam has met all expectations from both standpoints.

The city utilizes part of the current created at the dam for the operation of its own water works plant and the surplus current is sold to the local light and power plant. The rates made to the power plant were very low because of its taking surplus current, and these rates were reflected in reduced rates to the citizens. The plant has been operated by John W. Pray as superintendent.

The turbine and generators of this plant are in duplicate and have a total capacity of approximately 2000 h.p. The entire cost of the project was $160,000, $100,000 of which was raised by 25-year 4½ per cent bonds and the remaining $60,000 was paid out of the earnings of the municipal water works. The gross revenue for the fiscal year from April 1920 to April 1921 was $45,431 and the gross expenses for the year were $12,294, leaving a net profit over expenses of $33,237. Allowing a depreciation on an assumed life of the dam of 60 years and on that of the machinery and the power equipment of 25 years gives an annual depreciation of $2,220. The sinking fund for paying off the bonds in 25 years amounts to $4320 a year and the interest is $7,230, giving a total of $13,740 or, including operating expenses, of $26,034. Deducting

this from the gross revenue leaves a clear profit of $19,497 or 12.18 per cent on the total investment.

At this rate of return the city will have the project entirely free from debt before the expiration of the bonds, and at the latter end of the 25-year period, because of reduced interest and sinking funds, the project will be paying the city over 20 percent net on the investment. Although the income is high, the rates are low, the water works pumping plant being charged for current at the rate of 1 cent per kwh., while the surplus current is sold to the local light and power plant at 0.85 cents per kwh.

The city was able to borrow the funds for this development at 4½ percent, while a private company would probably have had to pay twice this rate, which item alone would have reduced the profit to less than 8 percent. This indicates one reason why a municipal plant should be able, if operated as efficiently and economically as a private one, to earn a larger profit.

In addition to the immediate profit from the plant, the city, by reason of being able to offer power at a low rate, possesses this advantage in efforts to secure new industries. The lake formed above the dam has created a pleasure resort which is enjoyed by large numbers of the citizens.

New Orleans Sewerage and Water Board Controversy

A controversy has been carried on for some weeks between the New Orleans Sewerage and Water Board and the Commission Council, which was finally taken to the courts and a decision was handed down December 6th by the civil district court for which an appeal has been asked for by the Commission Council.

The council made an appropriation of $188,000 for the use of the Sewerage and Water Board during the year 1922, but the board had insisted that this amount would be nowhere near adequate but that $424,000 would be necessary. The council had asked the board that it submit its books to the council's "Survey Commission" with a view to determining whether economies in the operation of the board might not be possible, but this the board had refused to do, and the council thereupon refused the demand of the board for $424,00, although the president and engineer of the board had stated that unless this sum were available the board would not be responsible for the continued operation of the drainage system throughout the year. The board obtained a temporary mandamus to compel the council to make the desired appropriation and Judge King of the civil district court returned a decision making this permanent. The commssioners have appealed from this decision to the Supreme Court. They state that if they are required to make this appropriation, the tax rate will have to be increased from 85 percent to 88 percent, or else the city must abandon its 1922 paving program.

Superintendent Earl of the board stated that he would not dare to ask for less than $424,000 if the city's drainage work is to go on. It was explained that much of the machinery of the drainage system is 20 years old and obsolete and that all the reserve funds that might be used for replacement have been exhausted and no others are available. Also the board is powerless to increase its water rates, its only source of income other than council appropriations. No reason appears to have been given publicly for the refusal of the board to permit an inspection of its books and records by the council's survey committee, which was apparently the point around which centered much of the hard feelings that appear to have engendered between the board and the council.

Engineering Lectures at Rutgers College

At Rutgers College a series of lectures is given under the auspices of the Student Branches of the A. S. C. E., the A. S. M. E. and the A. I. E. E. for the benefit of Freshmen, in order that they may have an outline of the many branches of the engineering profession and thereby have a better knowledge and purpose in the selection of their particular course and some understanding as to the qualifications of the engineer.

Civil Engineering was presented November 24 by C. D. Pollock, M. Am. Soc. C. E., of New York City, in a lecture entitled "Civil Engineering—Its Present and Future Prospects," and on December 1st George A. Orrok, consulting engineer for the N. Y. Edison Co. and power plant expert, lectured on "Central Station Development." On December 15th, C. R. Dooley, manager of personnel and training of the Standard Oil Co., will speak on the "Training and Qualification of the Electrical Engineer."

In the first of these Mr. Pollock, Prof. Harry N. Lendall informs us, "emphasized the fact that the successful engineer must be loyal to the profession and not consider the dollar paramount; that it is not necessary to specialize along any one particular line but, instead, to have a thorough grounding in methematics, physics and mechanics together with a broad training in economics, history and English.

"He then outlined the various branches of civil engineering, giving the scope and possibility of development in the future. Regarding the prospects for civil engineering students of today he said: 'Just now, due to business conditions, there is little demand for civil engineers. This is but a temperary condition in the development and progress of our country and the world at large. The electrification of railroads, the extension and improvement of highways, the development of water power and irrigation works, the thousands of rapidly growing towns and cities requiring new water and drainage systems, the new and increasing demand for engineer-executives, all of these will offer in the future many and growing opportunities for the young men who are now in our engineering schools.'"

Kansas City Votes Down Water Bonds

In November, 1920, Fuller & McClintock, consulting engineers of New York, presented to the board of fire and water commissioners of Kansas City, Mo., a very comprehensive report on improving the water supply of that city, embodying the result of an investigation made during the ten months previous. The general findings of this report have already been given in PUBLIC WORKS.

With a view to carrying out the recommendations of the engineers, the citizens were asked to vote at a special election November 22nd on a bond issue of $11,000,000. A two-third majority is required in favor of bond issues, and the vote is reported to have been slightly below this, although a fair majority of the votes were in favor of the issue.

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Percentages Deceptive

"A screen of two-inch mesh may give as high a percentage of removal of suspended matter as one of 30 meshes to the inch under certain conditions, such as the screening of clear water with only a tennis ball as the suspended matter, the percentage then being 100." This statement, made at the recent convention of the American Public Health Association, impressed the writer as an excellent illustration of the possible deceptiveness of percentage when used without full explanation of all the qualifying conditions.

But the deceptiveness is not confined to such extreme or unusual conditions. There are several uses made of percentages in water purification and sewage treatment work that are deceptive to the casual reader because of the method of using them. For instance, the records of the tests made on Chicago stockyards sewage show 353 parts per million of total suspended solids in the effluent as the average for July and 354 parts for the following April; but the efficiency of the screen in percentage reduction of suspended matter averaged 7.4 percent in the former month and 24.7 in the latter. Judged by percentage of reduction, the screen appeared to be more than three times as effective in April as in July; but in fact the result aimed at in screening, producing a clarified effluent, was exactly the same both months. By dumping some sawdust or other coarse matter into sewage it is possible to make a screen show very high *percentages* of clarification, or by adding quantities of colloidal matter to show very low ones. (In testing the clarifying efficiencies of settling tanks, *settling* solids are now used as the basis of comparison. Why not use the *screenable* solids in the effluent for comparing the efficiences of screens?)

Take again the matter of bacteria reduction. If a filter effects 99.5 percent reduction on a polluted water containing 60,000 bacteria per cc., there still remain in the effluent 300 bacteria per c.c. But a filter attaining only 85 percent efficiency when treating a water containing 600 bacteria per c.c. gives an effluent with only 90 bacteria per c.c. or only 30 percent as many as the first filter.

An even more deceptive use of percentages is that of describing sludge as having a certain percentage of moisture. (See the first article in this issue.) If a sludge containing 96 percent moisture be reduced to 48 percent moisture, it might be thought that one-half the water was removed and the volume of sludge reduced about one-half. As a matter of fact, in the first sludge there are twenty-four parts of water to one part of solid, while in the second there is slightly less than one part of water to one of solids, and as the solids are the same in each case (less a small percentage carried away with the excluded water) 96 percent of the original water has been removed and the sludge occupies about one-thirteenth of the original volume. This would be more apparent if the consistency be expressed in percentage of dry solids instead of water, as is done by English engineers, when the above sludges would be described as 4 percent dry solids and 52 percent dry solids respectively.

To specialists in the subject these ideas have become familiar and are not deceptive; but others are not apt to appreciate the real significance of such percentages, and it would seem advisable to change the practice so that the percentage would give directly rather than indirectly the true significance of the results.

The Science of Bidding

Considering the millions of dollars' worth of work that contractors bid upon and construct every year and the vital importance to them of bidding low enough to get the work but high enough to make a profit on it, it would seem as though successful contractors must have developed as great skill in estimating the cost of proposed work and bidding upon it as they have in executing it. (There is also probably an *art* as well as a *science* of bidding, or performing other acts connected more or less directly with bidding and having their effect upon the acceptance or rejection of the bid.)

When we come to examine bids, however, it is difficult to persuade ourselves that there is really such a thing as a science of bidding. Of course scientists

differ somewhat among themselves in their interpretation of data and in developing theories based upon them, but we do not find two scientists disagreeing widely in their opinions on matters such as the strength of steel or of concrete, or even that evasive unit, the bearing power of a given kind of soil, as compared with the differences found in bids upon the same work by different contractors.

An illustration is furnished by bids on contracts for the extension of the Catskill aqueduct, described elsewhere in this issue. The specifications for this work were unusually complete and explicit and the money involved, totaling from $1,000,000 to $3,000,000 on each contract, would seem to make it worth the contractors' while to analyze the conditions carefully and figure as closely as possible. Moreover, as the bidders were required to deposit with each bid a certified check for $25,000 and bonds for half a million dollars were required, it is to be assumed that they were contractors of experience and amply able to employ competent experts to figure for them.

In spite of this we find bids on one item varying from a lump sum of $6,000 by one bidder to $160,000 by another bidder, or nearly 30 times as great. This was for crossing of streams and highways, concerning which there might have been room for uncertainty. There would seem to be little uncertainty, however, in the furnishing and laying of steel pipe concerning which it is possible to calculate to a fraction of a percent the number of pounds to be handled, the number of rivets to be driven, etc. And yet for this item the bids varied from $25 per foot to $75 for one weight of pipe and from $35 to $110 for another weight; that is, one contractor was bidding about three times as much as another on an item which it would seem possible to estimate on very closely. There was also included in the contract more than 14,000 cubic yards of concrete masonry to be placed around the pipe and therefore under much the same conditions as would be involved in building a concrete sewer; that is, with the simplest of forms, into which the concrete could be poured continuously from the mixer. In spite of this condition, the bids varied from $6.42 to $27, or nearly 400 percent. Nor was the high bidder consistent in the altitute of his bids, since in several cases his bids was lower than the average; for instance, for 10,000 pounds of liquid chlorine he bid 10 cents per pound while the average of the fifteen bids was 15.2 cents.

These figures show contrasts that are remarkable if compared on the assumption that bidding is a science, but are not remarkable when considered in the light of bidding as it generally takes place. Differences of 50 percent to 100 percent in the amounts bid are by no means uncommon on all classes of work.

There are three assumptions that can be made to account for this condition. One is that many of the bidders cannot estimate within 50 percent of what it will cost them to do a given piece of work; another, that some contractors can do a given piece of work 50 percent cheaper than others. Probably each of these conditions play a part in the existing condition of wide variations between bids. The third assumption is that some contractors desire to make a big profit or none at all, and continually "take fliers" at lettings in a hope that some time they may win a contract at such a fat price that it will pay them for losing the others.

It is undoubtedly true (although not so much so now as formerly) that in many cases the lowest bidder could not possibly execute the work at the prices bid. In fact, we have heard it stated that where there is a large number of bidders the lowest quarter of the bids are generally below the lowest possible cost of construction, and the highest quarter are beyond reason, while the middle half represent intelligent and reasonable bidding by contractors who appreciate the difficulties of the work but are not attempting to make exorbitant profits.

Whatever the explanation, it would seem to be certain that there is much yet to be learned in contracting as a science if one contractor can execute almost any piece of work at half what it would cost another; and in the science of bidding, if experienced contractors differ among themselves by fifty percent in estimating the cost of doing a piece of work with no unusual hazards or construction features.

New York Highway Work in 1921

The state of New York has completed this year a larger amount of highway work than in any previous year of its history. Since February 1st, when Herbert S. Sisson took charge of the department, more than 615 miles of highway has been paved, on which it is estimated that the contractors have paid out more than $7,000,000 in wages. The contracts let this year amounted to $25,535,085. The unusually favorable weather conditions and the considerable decrease in cost of materials and labor have aided in making this a record year.

Of the construction this year, 366 miles were built of reinforced concrete, which was used for the heaviest traveled highways.

Considerable damage has been done to the roads in the past by trucks whose weight exceeded the limit set by law and the road inspectors this year have been instructed to enforce the law strictly and many arrests have been made for injuring the improved highways.

Milwaukee Sewage Plant Contracts

The Milwaukee sewerage commission has finally approved the plans for an activated sludge plant on Jones Island which is estimated to cost $2,000,000 and it is announced that bids for constructing it will be opened during the early part of 1922. It is expected that the construction of the plant will consume about two years.

Delaware's 1922 Highway Program

The state highway department of Delaware announces that its construction program of 1922 will total about $2,250,000 and that the first letting for construction will take place the last of February, giving several weeks in which successful bidders can prepare for beginning operations with the first favorable weather of the year.

Recent Legal Decisions

STREET RAILWAY'S DUTY AS TO PAVING BETWEEN AND OUTSIDE RAILS

In a proceeding on the complaint of a municipality alleging failure of street railway companies to comply with a municipal ordinance with respect to paving, the Pennsylvania Public Service Commissioner holds, Swarthmore v. Philadelphia, M. & S. St. Ry. Co., that an ordinance requiring the railways to pave the entire width of the streets and imposing other burdens which would require a prohibitive rate of fare, is unreasonable. Where a roadway had been allowed by the municipality and the street railway company occupying it to get into such a state of disrepair as to endanger public safety, it is held to be the duty of the railway company to place that part of the highway occupied by its tracks between the rails and on each side of the end of the ties, in a safe and adequate condition for vehicular and pedestrian travel as well as for the operation of its own cars. This should be done by laying pavement of the same kind as the municipality adopts for the remainder of the highway.

CITY MAY EXTEND TIME FOR COMPLETION OF PAVING CONTRACT AND SO PROTECT LIEN FOR ASSESSMENT

Suit was brought to set aside certain paving assessments and to cancel the lien thereof on the theory that the paving contract was not performed within the time specified therein and that the city had no authority to extend the time. The contract required complete performance by a certain date "unless otherwise provided in writing, signed by the mayor and approved by the city council," and that failing such completion the contractor should pay to the city any expenses incurred by it on account of its requiring additional time. The contract, therefore, made time of the essence of the contract, not for the purpose of forfeiture, but for the purpose of imposing certain penalties of additional expense upon the construction company in the event of its failure. The construction company was not released from the obligation of the contract by its mere failure to perform it within the time specified. The city elected to enforce the contract and to grant additional time for that purpose, as it was in their power to do. The Iowa Supreme Court therefore holds, O'Shonessy v. City of Sioux City, 184 N. W. 728, that the lien could not be cancelled for the contractor's failure to complete within the contract time.

ADJUSTMENT OF CHARGES AND RATES FOR MUNICIPAL ELECTRIC PLANT

In granting an increase of electric rates for the municipal plant of the Village of Argyle, the Wisconsin Railroad Commission holds that (1) separate schedules should be established for light and power service rendered by a municipal plant; (2) street lighting service should return to such a plant its share of the cost of the service; (3) a municipal electric plant should make a charge of energy used to operate the municipal stone crusher; (4) energy used for electric pumping in the municipal water plant should be metered, although the municipality owns the electric plant.

ORDINANCE PRESCRIBING THAT HOSPITAL BUILDINGS BE CONSTRUCTED OF NONINFLAMMABLE MATERIALS HELD AUTHORIZED AND REASONABLE

The Georgia Supreme Court holds, Brigham v. Mayor & Council of City of Dublin, 108 S. E. 532, that under a city charter giving power to pass ordinances, etc., necessary or proper or incident to good government and to the peace, security, health, etc., of the inhabitants, and all other powers necessary or incident to municipal government not in conflict with any other special power or authority given the city, the mayor and aldermen were authorized to pass an ordinance prescribing that buildings to be used for hospital purposes be constructed of brick or other noninflammable material. Such an ordinance was held not to be void on the ground that it was unreasonable.

RIGHTS OF ASSIGNEE OF CONTRACTOR NOT PRIOR TO THOSE OF MATERIALMEN AND SUBCONTRACTORS

A contract with a city (for the construction of a sewer outlet and specification plant) provided for the withholding of the contractor's account until he furnished evidence that material bills "filed with the mayor and city council" were paid, and that he should be paid the final estimate after deducting all unpaid bills. The Iowa Supreme Court holds, Reynolds v. City of Onawa, 184 N. W. 729, that an assignee of such contract as security for advances was not entitled to preference, in payment of the balance of the contract price by the city, over claims for labor and materials, on the ground that these claims were filed with the city clerk more than the 30 days specified by Iowa Code, § 3102, after the furnishing of the last item. The rights of the parties were held to be governed by the contract, not by the statute. and filing accounts with the clerk was a substantial compliance with the contract condition that they should be filed with the mayor and councils.

The rights of the assignee, a bank, were not rendered superior to those of the materialmen and subcontractors by the fact that the principal contract had been assigned very soon after it was executed and before the claims of subcontractors accrued. What the bank acquired under the assignment was the right to stand in the contractor's shoes, and demand and receive from the city just what the contractor himself could rightfully demand and receive, had he made no assignment. It was immaterial that the assignment was known to the city and to subcontractors when they furnished the materials.

DISCRIMINATION IN MUNICIPAL WATER RATES

In allowing an increased rate schedule for water to the City of Linton, as lessee of the Linton Water Company's plant, the Indiana Public Service Commission holds that a "step" schedule of water rates is discriminatory and often encourages waste of water to secure a lower rate. Such a schedule should therefore be changed to a "block" rate. It also holds that there is discrimination in water rates when flat rate consumers are billed at $7.50 per annum, including surcharge, and metered consumers at a minimum charge of $15 per annum.

NEWS OF THE SOCIETIES

Dec. 20—PHILADELPHIA SECTION, AMERICAN SOCIETY OF MECHANICAL ENGINEERS. Chamber of Commerce. Secretary, Prof. W. H. Kavanaugh Un. of Penn.

Dec. 22-23—KANSAS ENGINEERING SOCIETY. Annual meeting. Hutchinson, Kan. Secretary, J. M. Averill, Topeka.

Dec. 27-30—AMERICAN ECONOMIC ASSOCIATION. Pittsburgh, Pa.

Dec. 28-29 — AMERICAN ASSOCIA- FOR LABOR LEGISLATION. Fifteenth Annual Meeting Pittsburg. Frederick MacKenzie, Director of Publicity, 131 E 23rd St., New York.

Dec., 27-31 — AMERICAN ASSOCIATION FOR THE ADVANCEMENT OF SCIENCE, SMITHSONIAN INSTITUTE, Washington, D. C. Toronto, Canada.

Jan. 4-14 — CLEVELAND, OHIO, BUILDING EXPOSITION. Municipal auditorium, Cleveland, Ohio.

Jan. 5-6 — AMERICAN ENGINEERING COUNCIL, FEDERATED AMERICAN ENGINEERING SOCIETIES. Annual meeting, Washington, D. C.

Jan. 9 — MEMPHIS ENGINEERS' CLUB. Memphis, Tenn. Secretary, A. S. Fry, Memphis.

Jan. 12 — ENGINEERS' CLUB OF DES MOINES. Des Moines, Ia.

Jan. 12-14—HIGHWAY ENGINEERS' ASSOCIATION. Baltimore Hotel, Kansas City, Mo. Secretary, C. W. Brown, State Hgwy. Dept., Jefferson City, Mo.

Jan. 13 — ENGINEERS' CLUB OF SEATTLE. Seattle, Wash. Secretary, Lyman T. Banks, 916 L. C. Smith Bldg., Seattle.

Jan. 14—LOUISIANA ENGINEERING SOCIETY. New Orleans. La.

Jan. 17-19 — IOWA ENGINEERING SOCIETY. 34th annual meeting. Sioux City. Secretary—Lloyd A. Canfield, Des Moines, Ia.

Jan. 17-19—ASSOCIATED GENERAL CONTRACTORS. 3rd annual meeting. Hotel Winton, Cleveland Ohio.

Jan. 17-20—ASSOCIATION OF CANADIAN BUILDING AND CONSTRUCTION INDUSTRIES. 4th annual conference. Royal Connaught Hotel, Hamilton.

Jan. 17-20 — AMERICAN ROAD BUILDERS' ASSOCIATION. Annual Convention and good roads show. Chicago, Ill.

Jan. 18-19—AMERICAN SOCIETY OF CIVIL ENGINEERS. Annual meeting. New York City.

Jan. 20—BRIDGE BUILDERS' AND STRUCTURAL SOCIETY. New York City.

Jan. 27 — NEW YORK SECTION, AMERICAN INSTITUTE OF ELECTRICAL ENGINEERS. Engineering Societies' Bldg., New York City. Secretary—G. I. Rhodes, 115 Broadway, New York City.

Jan. 27-28 — WESTERN PAVING BRICK MANUFACTURERS' ASSOCIATION. Kansas City, Mo.

Jan. 30—SOCIETY OF AMERICAN MILITARY ENGINEERS. Washington, D. C.

Feb. 13-16—AMERICAN CONCRETE INSTITUTE. Annual Convention Cleveland. Secretary Harvey Whipple, 814 New Telegraph Bldg., Detroit, Mich.

Feb. 12-17 — CONFERENCE OF HIGHWAY ENGINEERING. 8th annual conference. University of Michigan, Ann Arbor, Mich.

Feb. 15-17—AMERICAN INSTITUTE OF ELECTRICAL ENGINEERS. Tenth midwinter convention. Engineering Societies' building, New York City.

Feb. 21-23 — MINNESOTA FEDERATION OF ARCHITECTS AND THE MINNESOTA SOCIETY OF CIVIL ENGINEERS. First annual convention Curtis Hotel, Minneapolis.

Apr. 27-30—BUILDING OFFICIALS' CONFERENCE. Apr. 27-28, Cleveland, O.; Apr. 29, Massillon, O.; Apr. 30, Youngstown, O.

May 15-19 — AMERICAN WATERWORKS ASSOCIATION. Annual convention. Philadelphia, Pa.

BROOKLYN ENGINEERS' CLUB

At the regular meeting, December 1, O. B. Whitaker, Superintendent of the Service Department of The Sperry Gyroscope Company, presented a paper illustrated by lantern slides, on: The influence of gyroscopic action in our daily existence; The application of the gyroscope to a compass; The Gyro Ship Stabilizer and results being obtained from it; Other applications of the gyroscope.

AMERICAN SOCIETY OF CIVIL ENGINEERS

The program for the adjourned November meeting of the Society, was divided into three sessions for the discussion of important topics at the afternoon meeting.

November 16.—There was a Symposium "Stream Pollution and Sewage Disposal." Speakers—George T. Hammond, Kenneth Allen, John F. Skinner, W. L. Stevenson, Earle B. Phelps, Paul Hansen, W. K. Dittoe, Langdon Pearse, and T. Chalkley Hatton.

November 16, 921, 8 p.m.—The Monthly Business Meeting was followed by a paper "Odors and their Travel Habits," by L. L. Tribus, published in August "Proceedings." Discussion led by George C. Whipple, Stephen De M. Gage, I. S. Osborn, Rudolph Hering, Olin H. Landreth, Andrew J. Prevost, and Robert S. Weston.

November 17—Symposium, "Water Supply and. Water Purification." Speakers—George C. Whipple, Allen Hazen, C. A. Emerson, C. E. A. Winslow, C. A. Holmquist, Robert S. Weston and Samuel A. Greeley.

AMERICAN SOC. OF MECHANICAL ENGINEERS

The 42nd annual meeting of the A.S. M. E. was held in New York City, December 5th-9th, and was devoted to the contribution of definite technical information of value in the elimination of industrial waste. The duties of engineers in relation to waste elimination, not only as professional men but as citizens was stressed by President Carman in his retiring address.

The professional divisions assisted greatly in the discussion. The Power Division presented papers on the heat balance of four large power stations, which brought out information of decided value in the determination of the most economical power-plant designs. Power-station operating efficiency, it was stated, cannot exceed that for which it was originally designed. The Fuel Division contributed four interesting papers pointing out the fundamentals involved in a program of fuel conservation. The Material Handling Division presented one paper which opened up the entire field of waste elimination by a more thorough utilization of materials-handling equipment. At the Gas Power Session Elmer A. Sperry presented the results of twenty years' work leading to the successful development of a compound Diesel engine.

The subject of education and training was given prominence at a session held on Mondayevening, December 5th, at which two papers were presented. Dean R. L. Sackett of Pennsylvania State College gave the results of an extended investigation into the methods of training developed in foreign countries and in the U. S. and Mr. D. C. Buell told of the work being done by the Railway Education Bureau of Omaha, Nebr., in the training of railroad men. It is the desire of the Committee on Education and Training in the Industries to bring out the fundamentals involved and to build the foundation for a constructive program of future industrial training.

On Thursday afternoon the Society for the Promotion of Engineering Education joined with the A.S.M.E. in a session to develop the subject of professional engineering for the industries. The needs of the industries were treated by F. C. Pratt of the General Electric Co. and president of the Yale Engineering Association and J. E. Otterson, president of the Winchester Repeating Arms Co.; and the problems of the engineering faculties by Dexter S. Kimball, Cornell University, and A. G. Christie, professor of mechanical engineering at Johns Hopkins University.

Important session meetings were the following: the Power Waste Session on the morning of December 6th, at which was discussed the heat balance of "Connors Creek Station of the Detroit Edison Co.," by C. H. Berry and F. E. Moreton; the "Colfax Station of the Duquesne Light Co.," by C. W. E. Clarke, of the "Delaware Station of the Philadelphia Elec. Co.," by E. L. Hopping, and of the "Hell Gate Station of the United Electric Light & Power Co.," by J. H. Lawrence and W. M. Keenan; the simultaneous sessions of the Management Waste Session and the Gas Power Session that afternoon, at the former of which W. N. Polakov spoke on "Making Work Facinating," and F. B. and L. M. Gilbreth discussed "The Process Chart," and at the latter of which Louis Illmer treated "Porting and Charging the Two-Stroke Oil Engines," and E. A. Sperry "Compounding the Combustion Engine"; the meeting of the Materials Handling Waste Session, the subject of which was "Industrial Waste in Handling of Material," by H. V. Coes, on the morning of December 8th; and on the afternoon of that day the joint session with the Society for the Promotion of Engineering Education, the subject of which was "Professional Engineering Education for the Industries."

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New Appliances

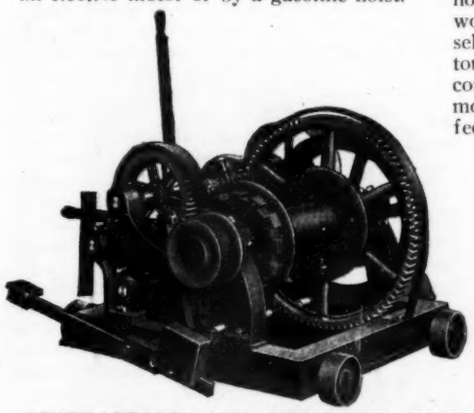
Describing New Machinery, Apparatus, Materials and Methods and Recent Interesting Installations

HOISTING ENGINES AND DERRICKS

Single and double drum steam and electric hoists, manufactured by the Street Bros. Machine Works, are illustrated in Catalog No. 24. Illustrations show hoists for derrick work and general construction as well as for special purposes; also marine equipment, including windlasses, cargo hoists, steering gears, and capstans. The catalog lists cableway engines, dredging engines, excavating machinery, drill frame hoists and derricks.

One of the steam driven hoists illustrated has two drums, mounted at right angles to each other, and a spur driven swinging gear for full circle derrick. A complete set of fittings for the mast and boom, includes turnbuckles for the guys, that are provided to accompany this engine.

A small single drum hoist, made in two sizes weighing 1800 pounds and 1975 pounds, has its frame mounted on four small wheels, making it portable and convenient for general construction purposes on buildings up to 5 or 6 stories high for which sufficient length of cable can be wound on the drum. This machine can be operated either by an electric motor or by a gasoline hoist.

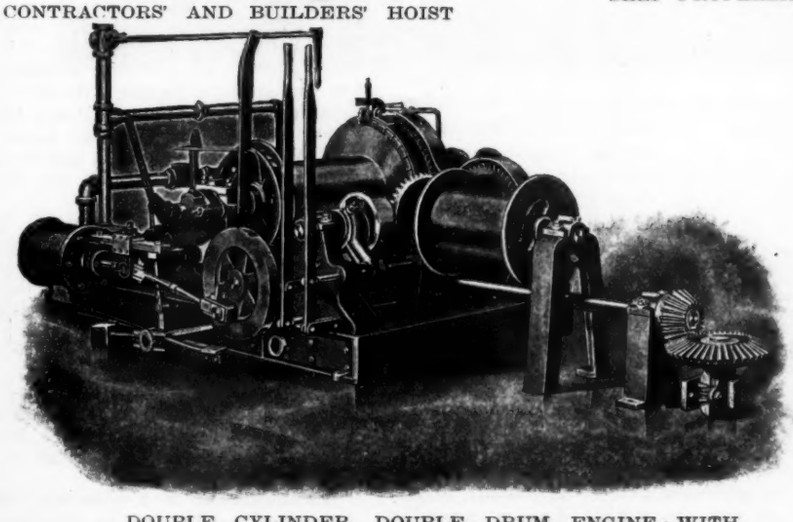


CONTRACTORS' AND BUILDERS' HOIST

The contractors and builders single drum hoist for building operations up to six stories may be driven either by an electric motor or a gasoline engine. The double cylinder drum engine with swinging gear for full circle crane is operated by steam or compressed air and is provided with a mitre gear, as shown in the illustration, which drives a vertical shaft, having at the lower end a pinion engaging a large circular rack for revolving the crane. With this engine there can be furnished standard gttings for the mast and boom, anchorage and bracing of the frame, and its rigging.

Single and double drum hoists are adapted to pile driving bridge erection and general contracting purposes, and are made of 15 to 60 h.p. There are also a double drum contractor's hoist without boiler, double drum derrick engine and an electric derrick hoist, four sizes, single and double drum electric hoists and belt driven hoists.

The catalog illustrates guy plates, goose necks, stiff leg irons, mast tops, brackets, bases and steps, boom ends, hook blocks and bull wheels for fitting wooden derricks and also illustrates a self-propelling derrick car of 5 to 20 tons capacity, guy and stiff leg derricks complete, and a traveling derrick mounted on a platform elevated several feet above the track.



DOUBLE CYLINDER, DOUBLE DRUM ENGINE WITH SWINGING GEAR FOR FULL CIRCLE CRANE

VICTORY SELF PROPELLING NOZZLE

The Victory Self Propelling Nozzle, with one man, water at 25 pounds pressure or more per square inch and hose, will remove sewer, pipe, drain or culvert blockades in less time, with less trouble and for less money than in any other way. It avoids digging up streets, prevents the expense of replacing destroyed pavements and automatically locates and breaks up sewer stoppages.

Instead of using sewer rods, which are apt to pack the blocade even tighter than before, the Victory Self Propelling Nozzle travels under its own power, without any pushing or shoving, right up to the obstruction, and the water breaks up hte blockade in record time.

The Victory Nozzle is made by The Self Propelling Nozzle Co., Inc., from high grade bronze castings, with a small forward hole, and six large rearward holes in the dome. Diagonal flanges are cast in the neck, wihch is connected with a threaded butt by a ball-bearing swivel. The diagonal flanges and ball-bearings give the nozzle its revolting motion with a minimum of friction. The force of the water entering the dome pushes the nozzle forward, sky-rocket fashion, about 25 feet a minute, pulling the hose after it until it reaches the

SELF PROPELLING NOZZLE FOR AUTOMATIC SERVICE

stoppage.

The forward stream of water breaks up the stoppage and the rearward stream washes it away. While this is going on, the nozzle is rapidly revolving, throwing the forcible rearward stream of water against the walls of the drain, so that as well as breaking up the blockade, they are giving the sewer a thorough cleansing.

Sewers more than two hundred feet long have been cleaned out and sand, stones, silt and sticks have been removed from them by using just water, hose and a Victory Nozzle. The Victory Nozzle is simple and compact. No working parts to get out of order. It is fool proof. Fires in soft coal piles, in cellars, under fallen walls, beneath roofs and in other inaccessible places are extinguished by the Victory Nozzle.

STEEL BODY HAND DUMPED IN 30 SECONDS, LOWERED BY GRAVITY IN 5 SECONDS

ARCHER END DUMP HOIST AND BODY

The end dump hoist and body for Ford trucks that is manufactured by Archer Iron Works is hand operated and designed so that the dumping operation requires but 30 seconds, while the body itself is lowered by gravity in five seconds or can be held in any inclined position by means of a pawl and ratchet.

The steel body, 7 feet long, 44 inches wide and 14 inches deep is provided with double acting tail gate, with removeable wooden flare boards and can also be furnished, if desired, with special slide gate arrangement.

The Archer hoists and bodies are built in sizes of 1 ton up to 5 tons, and to fit all makes of trucks. They are recommended for road paving and for general construction purposes. The price of the hoist and body, complete, and ready for attachment to the truck is $140.00 cash to the trade F.o.b. Chicago.

INDUSTRIAL NOTES

Maher Engineering Company, Contracting Engineers, with offices in Chicago, Detroit, and Cleveland, announce the following changes in their organization:

Mr. C. B. Adams has been appointed Vice President and Sales Manager.

The Golden-Anderson Valve Specialty Co., Pittsburgh, Pa., has appointed Lawrence G. Whitsit and F. W. DuBois as its Michigan representatives They will operate under the name of the Waterworks Equipment Co, with offices at 8242 Woodward avenue, Detroit, Mich.

The Conti-Augustine Co., recently organized at Tom River, N. J., to manufacture cement blocks, has opened a plant in Berkely, N. J. and installed new machinery and molds

VEHICULAR TUNNEL REPORT

The 1921 report of the New York State Bridge & Tunnel Commission to the Governor and Legislature of the State of New York is a valuable and interesting volume with more than 200 9 x 12 inch pages of text and illustrations, fully describing conditions of the vehicular tunnel from New York to New Jersey, outlining the proposed procedure in the execution of the work by means of nine principal contracts for the New York Land Shaft, Uew Jersey Land Shaft, New York River Tunnel & Shaft, New Jersey River & Land Tunnel and River Shaft, New York Approach, New Jersey Approach, Ventilation Equipment Building, New York; Ventilation Equipment Building, New Jersey, and Installation of Tunnel and Ventilating Equipment with a tentative programme for completion December 31, 1924.

Different types of design and methods of construction are discussed and compared, presenting the reasons for the preference given to cast iron lined tunnels driven by the shield method. Drawings are given of details of the proposed cast iron tubes 29 feet in diameter and traffic and ventilation conditions are summarized.

The appendixes give the recommendation of the advisory transportation engineering committee; extended mathematical analysis of the cast iron lining stresses and design; investigation of tunnel gases and the amount and composition of automobile exhaust gases including full descriptions of the method of sampling and analyzing exhaust gases and details of the apparatus employed and practical discussion of the results and conclusions; and a report of tunnel gas investigation problem number 2, of the physiological effects of the exhaust gases.

The book is illustrated by many tables, full page illustrations and engravings and is of special value in presenting the latest investigation on tunnel questions that have recently arisen and for which little data is generally available.

(Continued from page 474)

NEW ENGLAND WATER WORKS ASSOCIATION

The December meeting of the New England Water Works Association will be held on the 14th at the Hotel Brunswick, Boston. At 10 a.m is scheduled the meeting of the executive committee at the headquarters, Tremont Temple; and at 2 p.m. the following papers will be delivered: "Electrical Operation and Control of Gate Valves for Water Works Systems," by Peter Payne Dean, New York city, and "Two Years in China," by Thomas H. Wiggin, Scarsdale, N. Y.

WESTERN SOCIETY OF ENGINEERS

The program of this society for December includes the following: Dec. 5. "Economic Features of the St. Lawrence-Great Lakes Water Ways Projejct," by Francis Shenehon, Minneapolis; Dec. 15, "Economic Consideration of ,Line Revisions on the Delaware Lackawanna & Western R. R.," by George J. Ray, Hoboken, N. J.; Dec. 19, "Operation of Sewage Disposal Plants," by H. H. Wagenhals, associate sanitary engineer, U S. Public Health Service, Cincinnati.

NEW JERSEY ASSOCIATION OF COUNTY ENGINEERS

Members of the Association and guests left Trenton 9.00 a.m., November 18th, via. Automobiles and inspected Brunswick Pike in Mercer and Middlesex Counties, and proceeded to Clarksville, to Lawrence Station, to Mercerville, Hamilton Square, Route No. 1, to Hightstown, to Manalapan, passing over State Maintenance work; turn left, Manalapan to Englishtown, passing Molly Pitcher's well, and Monmouth Battlefield, thence to Freehold, and inspected interesting Monmouth County work thereabouts.

After Luncheon at Lakewood, the party visited hangar built by Navy Department near Lakehurst for ZR-2 and proceeded over gravel roads through Monmouth, Burlington and Atlantic Counties, along Jersey Coast, dining at Sea View Golf Club, between Oceanville and Abescon. Inspected nearby New Highway Lighting Scheme of General Electric Co. and held meeting at 9.00 p.m. at Hotel Dennis, Atlantic City. Saturday visited Atlantic County bituminous work during morning. Lunched at Bridgeton Country Club and in the Afternoon, inspected work on State and county roads.

The following subjects were announced for discussion at the meeting:

Advisability of Counties building part of State Highway System under Reimbursement Act, as proposed by Highway Commission.

Exchange of ideas with Delaware and Pennsylvania Engineers.

Reports of Standing Committees.

Proposition of admission of Assistant County Engineers as Associate Members of New Jersey Association of County Engineers.

Establishment of a Clearing House for use of members of the Association, to be conducted by Secretary.